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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	Frattini *et al.*	Confirmation No.:	4759
Serial No.:	10/014,619	Art Unit:	3641
Filed:	December 10, 2001	Examiner:	Palabrica, Ricardo J.
For:	Apparatus and Method for Ultrasonically Cleaning Irradiated Nuclear Fuel Assemblies	Attorney Docket No:	060825-0306-US

DECLARATION UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

I, David J. Gross, declare and state that:

1. I graduated from Massachusetts Institute of Technology with a B.S. and an M.S. in Mechanical Engineering. I am a registered professional engineer with over 18 years of engineering experience. I have also been an author or co-author for at least 45 technical papers of which many relate to ultrasonic cleaning devices used in nuclear power plants.

2. Currently, I am a Senior Engineer and Principal Officer at Dominion Engineering, Inc. where I am and have been responsible for design, analysis, and laboratory qualification of ultrasonic cleaning devices used in nuclear power plants for the last 15 years.

3. As a consequence of my education and extensive experience in the field of ultrasonic cleaning and nuclear power plants, particularly in the cleaning of irradiated nuclear fuel assemblies, I am aware of industry practice and the level of skill in that field.

4. While Dominion Engineering is a contractor for the assignee of the above subject patent application (U.S. Patent Application No. 10/014,619, referred to hereinafter as the "Application") as well as a licensee of the Application, I am not an inventor of the invention described in the Application and, therefore, offer this objective Declaration.

5. For the purpose of this Declaration, I reviewed the Application and the currently pending claims numbered 21-26 and 29-40. I have also reviewed the Office Action mailed on July 20, 2004 (the "Office Action") and the references cited therein, including U.S. Patent No. 5,467,791 (Kato); U.S. Patent No. 5,200,666 (Walter); and (U.S. Patent No. 5,337,446 (Smith).

6. I understand that all of the pending claims recite transducers that each produce omnidirectional waves.

7. In connection with claims 21-26 and 29, I understand that the Examiner does not agree that Kato only teaches the use of transducers that produce planar waves, as opposed to transducers that produce omnidirectional waves as recited in the pending claims. Further, I understand that the Examiner states that Kato does not explicitly preclude the use the omnidirectional transducers.

8. In connection with claims 31, 32 and 37-39, I understand that the Examiner has rejected these claims as being obvious over Kato in view of Walter. Further, I understand that the Examiner admits that Kato does not specify the type of transducer used, but, regardless, the Examiner contends that it would have been obvious to replace the transducers as taught by Kato with the transducers taught by Walter.

9. I understand that for the purposes of establishing a prima facie case of obviousness, the Examiner must establish at least (i) a suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings and (ii) a reasonable expectation of success in such combination.

10. As a result of my review of the Application, the pending claims and the references cited in the Office Action, and based on my knowledge about the state of the art, I conclude that neither I, nor one of ordinary skill of the art, would have been motivated to combine, or would have had a reasonable expectation of success in the combination of, the teachings of Kato and Walter. Specifically, neither I, nor one of ordinary skill in the art, would have been motivated to replace the transducers in Kato with the transducers taught by Walter.

11. Even though Kato does not explicitly state that the transducers used are planar transducers, Kato only teaches the use of planar transducers. Further, given the design of Kato's apparatus and Kato's teaching of only planar transducers, neither I, nor one of ordinary skill in the art, would be motivated to replace the transducers of Kato with the transducers taught by Walter. The following points provide the basis for these conclusions.

    a) To illustrate why Kato only uses planar transducers, one has to account for the differences in the physical nature and energy fields that emanate from planar transducers versus the omnidirectional transducers described in Walter.

As conventionally defined in the industry, submersible planar transducers typically comprise a sealed, rectangular six-sided box containing a plurality of driving devices bonded to the interior surface of only one of these six sides, thereby creating an "active face." This active face is typically the face with the largest surface area and would be placed in the direction of the target object to be cleaned. The waves generated from this active face then travel in that one particular direction. Moreover, this active face is often depicted as the face that is offset by a specified distance from the target object. For example, in the upper left illustration in Fig. 11 of Kato, it would be conventional when using planar transducers for the active face to be the face that is shown as 100 mm from the object to be cleaned. Also, planar transducers are often depicted as rectangular boxes.

On the other hand, omnidirectional transducers are rod-shaped and transmit their energy in the radial direction, as viewed in a cylindrical coordinate system centered on the axis of the transducer. In other words, they generate energy from all directions. Although these transducers work by the principle of a resonant standing wave and, therefore, have axial variations (nodes and anti-nodes), they are axisymmetric and have no circumferential variations. Waves from planar transducers, however, do not have nodes and anti-nodes and only generate waves in a single direction, which is in a direction normal to and away from the active face.

These fundamental differences between planar and omnidirectional transducers make it apparent whether an apparatus is designed for planar transducers or omnidirectional transducers.

b) Kato states in part: " . . . ultrasonic waves . . . facing each of the faces . . . are directed onto the fuel assembly . . . ." (Kato, col. 6, line 12.) This description clearly refers to a planar distribution of energy because only planar transducers have active faces. Kato also states " . . . ultrasonic waves are incident at right angles (90°) onto channel box 106, the faces being arranged parallel to fuel assembly . . . ." (Kato, col. 7, line 47.) This phrase only makes sense only in the context of planar transducers because planar transducers only produce single surface energy waves that travel straight in a given direction.

In contrast, the omnidirectional energy emanated from the surface of the omnidirectional transducers described in the present Application cannot be incident at right angles to any flat surface. Omnidirectional transducers emanate energy that is scattered in all directions. For this type of energy to be incident on the "wave reflecting structure" from the "perpendicular (90° direction)", the reflecting structure would need to be cylindrical, and all of the transducers would need to be concentric with a reflector, *i.e.*, the transducers would have to be placed in the center of the cylindrical object, which is not shown by Kato (see, *e.g.*, Kato, Figure 6, which shows the transducers placed within a square structure).

c) Kato also describes lower cleaning efficiency near the corners of the fuel assembly, stating that "the ultrasonic wave intensity is lower for the edge region

of ultrasonic transducers 111 than in the middle region". (Kato, col. 7, line 64.) The concepts of an "edge" and a "middle" apply only to planar transducers because of the planar transducers' rectangular, boxy shape. Also, as noted earlier, omnidirectional transducers are rod-shaped and "edge" and "middle" regions would not be associated with rod-shaped omnidirectional transducers.

d) Additionally, Kato specifies transducer energy as "at least 1 W/cm^2." (Kato, col. 11, line 24.) The units "per square centimeter" clearly imply that the use of planar transducers. Omnidirectional transducers are typically described in terms of power per unit volume (*e.g.*, W/l or W/gal) in the intended cleaning bath geometry, because the surface energy varies so significantly over the surface of the transducer. For example, when using omnidirectional transducers, the surface exhibits nodes and anti-nodes of vibration with surface energies ranging from the equivalent of 0 W/cm^2 near these nodes to in excess of 5 W/cm^2 at the anti-nodes, versus what would otherwise be a uniform value in W/cm^2 across the face of a planar transducer. In light of the above, the use of omnidirectional transducers is incompatible with Kato's specification of transducer energy being "at least 1 W/cm^2" because the nodes from an omnidirectional wave have less than 1 W/cm^2 and the anti-nodes have greater than 5 W/cm^2.

e) The drawings in Kato also clearly depict planar-type transducers (see Item 111 in several of the drawings) because of the rectangular shape shown. Omnidirectional transducers are rod-shaped and would not be depicted as a rectangular box, as shown in Kato's drawings.

f) In discussing the prior art, Kato references EPRI NP-4122 and describes it in connection with Figs. 3 and 4. (Kato, col. 3, lines 20-29.) This reference teaches the use of planar transducers. Notably, Kato does not describe the use of such planar transducers as a problem. Moreover, Kato does not describe the use of other types of transducers. Therefore, it can be clearly inferred that Kato simply used planar transducers, and such an inference is reasonable since the majority of ultrasonic transducers used over the past decade are planar transducers.

g) Given that Kato only teaches the use of planar transducers and that the design of Kato's apparatus is, therefore, for use with planar transducers, one would not substitute omnidirectional transducers as taught by Walter in the apparatus of Kato.

First, comparing planar transducers and omnidirectional transducers is like comparing apples and oranges, particularly in light of the differences between planar and omnidirectional transducers as discussed above, and one would not simply substitute one type of transducer for another. In fact, simply replacing one type of transducer with another type is contrary to accepted or standard practice in this technical field.

Moreover, the design of the apparatus in which the transducers are used is an important consideration in selecting the type of transducer. In fact, the design of the apparatus is typically based upon the type of transducer to be used. The

design of Kato is for planar transducers and the energy emanated by planar transducers. One would not then, simply substitute an omnidirectional transducer into the apparatus of Kato. As noted, omnidirectional transducers emanate energy in all directions, and the use of omnidirectional transducers in the apparatus of Kato would result in a loss of energy and inefficiency. For example, while Kato shows a steel housing 127 as a ultrasonic wave reflector, the square geometry of this housing would not be an appropriate geometry for use with omnidirectional transducers. A more appropriate reflecting structure for omnidirectional transducers would be cylindrical, with the part to be cleaned in the center of the cylindrical reflector and a plurality of transducers oriented vertically arranged uniformly around the circumference of the part. Also, it would not be appropriate for the transducers to be arranged in the same axial plane; it would be preferable to arrange the transducers so that the nodes and anti-nodes of adjacent transducers are offset axially so as to distribute the energy more uniformly. Therefore, the use of omnidirectional transducers in the design of Kato would result in energy inefficiency, and one would not be motivated to use omnidirectional transducers in the manner nor expect that such use would be successful.

Based on the foregoing, I conclude that Kato only describes the use of planar transducers. Kato does not offer any suggestion or motivation to replace these planar transducers with omnidirectional transducers. Because the Kato apparatus was clearly designed to be used with planar transducers, I would not be motivated to, nor would I have an expectation of success in, replacing the planar transducers in Kato with the omnidirectional transducers taught by Walter. Further, it would be contrary to standard practice to simply replace a planar transducer in a given apparatus with an omnidirectional transducer, particularly where the apparatus has been designed for use with planar transducers.

12. With respect to Smith, it is apparent that planar transducers are used in Smith's apparatus and that omnidirectional transducers would not be used in the design taught by Smith. The following points provide the basis for these conclusions.

    a. The invention disclosed in Smith consists of a plurality of "sonic plates" arranged radially outward from a central post or, alternatively, radially inward from the walls of a cylindrical vessel. (Smith, col. 4, lines 37-39.) This is not the same as a device employing omnidirectional transducers because omnidirectional transducers generate waves in all directions and are not limited to a radially inward or outward direction as described in Smith.

    b. Each of the "sonic plates" shown in Fig. 3 of Smith are clearly planar transducers. This is clear from the illustrative lines projecting in a single direction from each plate in Figure 3 and from the specification, which states "with sonic waves directed inward to converge at the center of the pressure vessel". (Smith, col. 2, line 55.) The energy from omnidirectional transducers cannot (by definition) be oriented in such a manner as to converge at a single point. Accordingly, it is not obvious that the invention disclosed in Smith could be modified to make use of omnidirectional transducers, as

omnidirectional transducers cannot be focused on a central point in the apparatus.

13. I hereby declare that all statements made in this Declaration are true to the best of my knowledge; that all statements made on information and belief are believed to be true; that these statements are made knowing that willful false statements so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code; and, that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: JAN. 15, 2005 By: _____

David J. Gross